

Brain Waves

Spring 2011

Semiannual Newsletter

Neuroscience Training Program

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UW-Madison Scientists: Distinctive Sleep Pattern Could Reveal Schizophrenia

Date Published: 11/23/2010

University Communications

Madison, Wisconsin - When people with schizophrenia sleep, their brain waves show a distinctive pattern that may someday lead to one of the first biological markers for this devastating mental illness.

A team of sleep scientists led by Dr. Fabio Ferrarelli of the University of Wisconsin-Madison found that during non-rapid eye movement sleep (non-REM, or dreamless sleep), the brain waves produced by people with schizophrenia lack the normal pattern of slow and fast spindles.

Someday, use of a common electroencephalogram (EEG) test could confirm suspicions of the disease, or identify young people at risk of schizophrenia.

"Schizophrenia is probably the most devastating chronic mental illness, in terms of its impact on the individual and its cost to society," says Ferrarelli, a researcher in the laboratory of psychiatry professor Dr. Giulio Tononi.

"It's a chronic disease, with a strong genetic component, but we don't have a biological marker to identify patients with schizophrenia. Currently we diagnose these patients according to their symptoms, which vary greatly among individuals."

But in sleep, at least, people with schizophrenia show a similar pattern.

The team used EEG recording to map the full-night brain wave patterns of 49 people with schizophrenia and 44 healthy people. In addition, they assessed another 20 people who were taking anti-psychotic medication for conditions other than schizophrenia.

About 90 percent of the people diagnosed with schizophrenia showed deficits in sleep spindles, the most common brain waves occurring during non-REM sleep. By contrast, people from the healthy and medicated-but-not-schizophrenic groups showed a regular spindle pattern. The results confirm those from an earlier study.

Another component of non-REM sleep, known as slow waves, didn't vary among the groups.

Co-author Dr. Michael Peterson, assistant professor of psychiatry, says that spindles are mostly produced in the thalamus, a structure in the center of the brain that coordinates incoming stimuli and sends it along to the cerebral cortex. Slow waves are produced mostly in the cortex.

"This study seems to show that the thalamus is particularly important in schizophrenia," Peterson says.

A malfunction in the thalamus could help explain why schizophrenics see and hear things that aren't there.

"If the thalamus doesn't do its job of filtering out unnecessary information, the brain might be unable to ignore stimuli," says Ferrarelli.

This theory lends credence to the idea that brain waves during could be used as a diagnostic test.

"The goal is to find a biological marker that is consistent and related to the fundamental deficits of the disease," Ferrarelli says.

While the research project used an EEG cap with 256 electrodes, only a handful of them are needed to map the crucial brain waves, meaning the test could be performed in most hospitals with an EEG.

The study was published in the November edition of the American Journal of Psychiatry.

Congratulations to the students
who have passed their preliminary
examinations!

Kile Mangan, Brianna Schuyler, Yejie
(Amy) Shi

CONTRIBUTIONS TO THE PROGRAM

Funds given to the program are used to support recruiting activities, guest speakers, the undergraduate award in neurobiology research and the annual program picnic. For additional information, please contact the program office at (608)262-4932. To contribute, please contact the UW Foundation at: www.uwfoundation.wisc.edu

Thank you to all those who have contributed and continue to support the Neuroscience Training Program and its students.

Congratulations Recent Graduates!

Robert Krencik graduated from Su-Chun Zhang's lab and will continue working as a post-doc in Zhang's lab.

Eric Landsness graduated from Giulio Tononi's lab and will be returning to Medical School.

Courtney Guenther graduated from Gordon Mitchell's lab and will be teaching at Horry-Georgetown Technical College.

Keith Hengen graduated from Mary Behan's lab and started a post-doc at Brandeis University with Gina Turigiano.

Jessica Jarecki graduated from Antony Stretton's lab and will be focusing on her new family before a post doc position.

Brady Riedner graduated from Giulio Tononi's lab and is pursuing post-doc options.



NTP Student Lindsay Pascal & Professor Brian Baldo
Photo by: Bryce Richter

For First Time, Monkeys Recognize Themselves in the Mirror, Indicating Self-Awareness

by David Tenenbaum
Sept. 29, 2010

Typically, monkeys don't know what to make of a mirror. They may ignore it or interpret their reflection as another, invading monkey, but they don't recognize the reflection as their own image. Chimpanzees and people pass this "mark" test — they obviously recognize their own reflection and make funny faces, look at a temporary mark that the scientists have placed on their face or wonder how they got so old and grey.

For 40 years, scientists have concluded from this type of behavior that a few species are self-aware — they recognize the boundaries between themselves and the physical world.

Because chimps, our closest relatives, pass the test, while almost all other primate species fail it, scientists began to discuss a "cognitive divide" between the highest primates and the rest.

But a study published today (Sept. 29) by Luis Populin, a professor of anatomy at the University of Wisconsin-Madison, shows that under specific conditions, a rhesus macaque monkey that normally would fail the mark test can still recognize itself in the mirror and perform actions that scientists would expect from animals that are self-aware.

The finding casts doubt on both the relevance of the mark test and on the existence of a definitive cognitive divide between higher and lower primates.

Populin, who studies the neural basis of perception and behavior, had placed head implants on two rhesus macaque monkeys, while preparing to study attention deficit disorder. Then Abigail Rajala, an experienced animal technician who is in the university's Neuroscience Training Program, mentioned that one of the monkeys could recognize himself in a small mirror. "I told her the scientific literature says they can't do this," says Populin, "so we decided to do a simple study."

Much to his delight, it turned out that the graduate student was right.

In the standard mark test, a harmless mark is put on the animal's face, where it can only be seen in a mirror. If the animal stares at the mirror and touches the mark, it is said to be self-aware: It knows that the mirror shows its own reflection, not that of another animal. (Animals that lack self-awareness may, for example, search for the "invading" animal behind the mirror.)

Rhesus macaques, a mainstay of medical and psychological research, have long failed the mark test.

But in Populin's lab, the monkeys that got the implants were clearly looking in the mirror while examining and grooming their

foreheads, near the implant. Tellingly, they were also examining areas on their body, particularly the genitals, that they had never seen before. In some cases, the monkeys even turned themselves upside down during these examinations. In other cases, they grasped and adjusted the mirror to get a better view of themselves.

When the researchers covered the mirror glass with black plastic, these behaviors disappeared, and the monkeys ignored what had been a subject of fascination.

Furthermore, although a macaque will often interpret its reflection as representing an intruding monkey and adopt either an aggressive or submissive response, the implanted monkeys showed dramatically fewer of those "social" behaviors compared to the behaviors, such as exploring hidden body parts, that indicate self-awareness, Populin says.

"This report makes a unique contribution to our views about primate self-awareness because the 'mirror test' has been the traditional gold standard for determining if a person and/or animal met a criterion for having a sense of self," says Christopher Coe, a primatologist and professor of psychology at UW-Madison. "If a young child, brain-damaged adult or animal was able to recognize and appreciate that the image in the reflection was really them, then it was interpreted as proof of being aware."

Thus, Coe says, "If we follow that logic through with the belief that mirror recognition is proof of a sense of self, then we need to extend that attribute at least to rhesus monkeys."

Scientists who have used the mark test to explore self-awareness have found the quality in one species of bird, in one individual elephant, and in dolphins and orangutans. And so instead of asking how self-awareness evolved only among primates, they face the larger question of how it evolved multiple times in distantly related species.

The study may refine how the mark test is used, Populin says. "We clearly have data showing that these animals recognize themselves in the mirror, but fail the mark test."

The mounting data on self-awareness has undermined the concept of a cognitive divide in the primate lineage, Populin says. "There is another idea in primatology, and Charles Snowdon of UW-Madison has contributed to this, that instead of a divide, self-awareness has evolved along a continuum, so we will find it in different forms in different locations on the tree of evolution. I think the mark test may not be sensitive enough to detect self-awareness in the lower species; they may have it, but in a different form, and it may show up in different situations, using different tests."



NTP Student Kimberly Farbota during outreach event with middle schoolers.

Awards & Achievements

Ashutosh Dharap - was awarded the Vilas Research Travel Grant

Melissa Harris - was awarded a Neuroscience Training Program Travel Grant

Ginny Hu - was awarded a Neuroscience Training Program Travel Grant

Kile Mangan - received a one year Epilepsy Foundation Health Sciences Student Fellowship Award

Jesus Mena - was awarded a pre-doctoral National Research Service Award (NRSA) Fellowship & will be published in the Journal of Neuroscience in the spring

Olga Ponomareva - was awarded a pre-doctoral National Research Service Award (NRSA) Fellowship

Wyatt Potter - received a one year Epilepsy Foundation Health Sciences Student Fellowship Award



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Spring 2011 Events

Thursday, Jan. 27th

Integrating Research and Ethics Symposium

Debrah Parrish, Parrish Law Offices

When things don't go as planned...

Thursday & Friday, April 28-29th

10th Annual International Bioethics Forum

Biotechnology Institute, BICI-Promega

Manifesting the Mind-Further Explorations of Human

Consciousness

Woolsey Lecture

Thursday, April 28th

Gail Mandel, Vollum Institute

Dept. of Neuroscience Seminar Series

Thursday, March 10th

4:00 PM, Genetics Biotech Rm. 1111

Alex Kolodkin, Johns Hopkins University

Wednesday, April 6th

12:00 PM, 281 Medical Sciences Center

Cranefield Lecture Heping (Peace) Cheng, Peking University

Wednesday, April 20th

12:00 PM, 140 Bardeen

Bruce Bean, Harvard University

Thursday, April 21st

12:00 PM, 281 Medical Sciences Center

Donna Korol, University of Illinois

Wednesday, May 4th

12:00 PM, 140 Bardeen

Ranulfo Romo, UNAM / HHMI

Center for Neuroscience Lectures

Thursday, March 31st

4:00 PM, 281 Medical Sciences Center

Roberta Diaz-Brinton, University of Southern California

Thursday, May 5th

4:00 PM, 281 Medical Sciences Center

John O'Connor, University College Dublin

Neuroscience and Public Policy Seminar Series

Friday, January 28th

4:00 PM, Bardeen Rm. 341

Debra Parrish, Parrish Law Offices

How to Avoid Research Misconduct and Stay Out of Jail

Friday, February 11th

4:00 PM, Bardeen Rm. 341

Adrian Raine, University of Pennsylvania

Neurocriminology

Friday, March 4th

4:00 PM, Genetics Biotech Rm. 1111

Bruce Alberts, University of California - San Francisco

Science and the World's Future

Friday, April 15th

4:00 PM, Bardeen Rm. 341

Mark Frankel, Director, Scientific Freedom, Responsibility and Law Program, AAAS

The Brain on Trial: The Challenge Neuroscience Poses for the Law

3rd Annual Paul Bach-y-Rita Mem. Lect. Friday, April 29th

4:00 PM, Genetics Biotech Rm. 1111

Pawan Sinha, Massachusetts Institute of Technology

Project Prakash: Combining Science and Service

Look for more information on future lectures at:

<http://www.ntp.neuroscience.wisc.edu/>